

## **Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge Quarterly Update Report – July 2006**

Prepared by:

Matt Harwell, A.R.M. Loxahatchee National Wildlife Refuge

With contributions from Laura Brandt, Leslie MacGregor (NPS), Donatto Surratt,  
and Mike Waldon

### Overview

This update is a summary of activities since the previous status report of January 2006 on the implementation of the Refuge's Enhanced Water Quality Monitoring and Modeling Program. A project overview, and other detailed information about the program can be found at: [http://sofia.usgs.gov/lox\\_monitor\\_model/](http://sofia.usgs.gov/lox_monitor_model/). The primary objective of this overall program focuses on providing information for use in ecological management of the Refuge (Brandt et al. 2004; Harwell et al. 2005).

The Refuge's monitoring component of this program also addresses one of the Consent Decree Principals recommendations (17 December 2003):

#### ***B. Enhancing Monitoring of the Refuge***

*Design and implement an enhanced monitoring program to improve spatial and temporal understanding of factors related to phosphorus dynamics.*

The Refuge's modeling component of this program also addresses several of the Consent Decree Principals recommendations (17 December 2003):

#### ***C. Modeling of the Refuge***

- 1. Develop a water quality/hydraulic model for the Refuge with a phosphorus cycling component.*
- 2. Evaluate issues associated with phosphorus loads and transports within the L-40 and L-7 canals.*
- 3. Develop and track a simple phosphorus mass-balance model for the Refuge.*

### Information Availability

Through collaboration with USGS, information from the Refuge's Enhanced Water Quality Monitoring and Modeling Program has been made available on the USGS' SOFIA web site at: [http://sofia.usgs.gov/lox\\_monitor\\_model/](http://sofia.usgs.gov/lox_monitor_model/).

Final data for monthly samples through May 2006 are publicly posted on DBHYDRO by the SFWMD at <http://www.sfwmd.gov/org/ema/dbhydro/index.html>. Because water quality analyses contracted to the South Florida Water Management District (SFWMD) concluded in May 2006 (see below), data after May 2006 are not posted on DBHYDRO.

It is anticipated that total phosphorus data will be posted on the Technical Oversight Committee's web site at <http://www.sfwmd.gov/org/ema/toc/index.html>.

#### Monitoring Update (April – June 2006)

The interagency contract with the SFWMD to provide analytical chemical services for USFWS enhanced monitoring sample processing has expired. The SFWMD declined extending the contract because of laboratory capacity limitations. Starting in June 2006, laboratory analyses previously conducted by SFWMD are being performed under contract to the USFWS by Columbia Analytical Services (CAS). CAS is a participant in the Everglades Round Robin program. Efforts are underway to gain permission and identify procedures by which new USFWS data can continue to be made available to the public on SFWMD's DBHYDRO website.

Sampling of the enhanced water quality monitoring network (Figure 1) occurred at 18 stations in April 2006, 6 stations in May 2006, and 9 stations in June 2006 (Table 1).

Total phosphorus data for 2005-2006 are presented in Table 1. Maps of TP for April and May 2006 are presented in Figures 2 and 3. The June 2006 map was not available at the time of this writing

Conductivity sonde deployment information for 2005-2006 is presented in Table 2.

#### Modeling Update

Model development continues. The modeling team is also developing simplified water budget and mass budget models for the Refuge. Three presentations on the modeling effort were made at the June 2006 Greater Everglades Ecosystem Restoration conference (Meselhe et al. 2006a, b; Waldon 2006).

#### Water Quality Data Analyses Updates

Water quality analyses continue, including analysis of transect water quality data. The present focus is on data analysis for the 2006 Annual Report. Two presentations on the water quality analyses were made at the June 2006 Greater Everglades Ecosystem Restoration conference (Surratt et al., 2006a, b).

#### Next Steps

The next steps for this program continue to focus on data collection and analysis and continuing forward with model development.

#### References

[http://sofia.usgs.gov/lox\\_monitor\\_model/](http://sofia.usgs.gov/lox_monitor_model/)

Brandt, L.A., Harwell, M., Waldon, M. (2004) Work Plan: Water Quality Monitoring and Modeling for the A.R.M. Loxahatchee National Wildlife Refuge: 2004-2006. Prepared for the A.R.M. Loxahatchee National Wildlife Refuge. April, 2004. 33 pp.

- Harwell, M. Surratt, D., Waldon, M., Walker, B., Brandt, L. (2005) A.R.M. Loxahatchee National Wildlife Refuge Enhanced Water Quality Monitoring and Modeling Interim Report. April, 2005. 106 pp.
- Meselhe, E.A., Arceneaux, J.C., Griborio, A.G., Habib, E., Waldon, M.G. (2006a) Arthur R. Marshall Loxahatchee National Wildlife Refuge Water Budget Model. 2006 Greater Everglades Ecosystem Restoration Conference, Lake Buena Vista, Florida. June, 2006.
- Meselhe, E.A., Griborio, A.G., Arceneaux, J.C., Waldon, M.G. (2006b) Hydrodynamic Modeling of the A.R.M. Loxahatchee National Wildlife Refuge. 2006 Greater Everglades Ecosystem Restoration Conference, Lake Buena Vista, Florida. June, 2006.
- Surratt, D., Waldon, M., Harwell, M. (2006) Standard characterization of canal water penetration into the interior marsh of the A.R.M. Loxahatchee National Wildlife Refuge. Oral Presentation at the Greater Everglades Ecosystem Restoration Science Conference. June, 2006.
- Surratt, D., Waldon, M., Harwell, M. (2006) A new analysis approach for characterizing canal water penetration into wetlands – a case study of the A.R.M. Loxahatchee National Wildlife Refuge. Oral Presentation at the Greater Everglades Ecosystem Restoration Science Conference. June, 2006.
- Waldon, M.G. (2006) Simplified Modeling of Canal Water Intrusion in the Arthur R. Marshall Loxahatchee National Wildlife Refuge. 2006 Greater Everglades Ecosystem Restoration Conference, Lake Buena Vista, Florida. June, 2006.

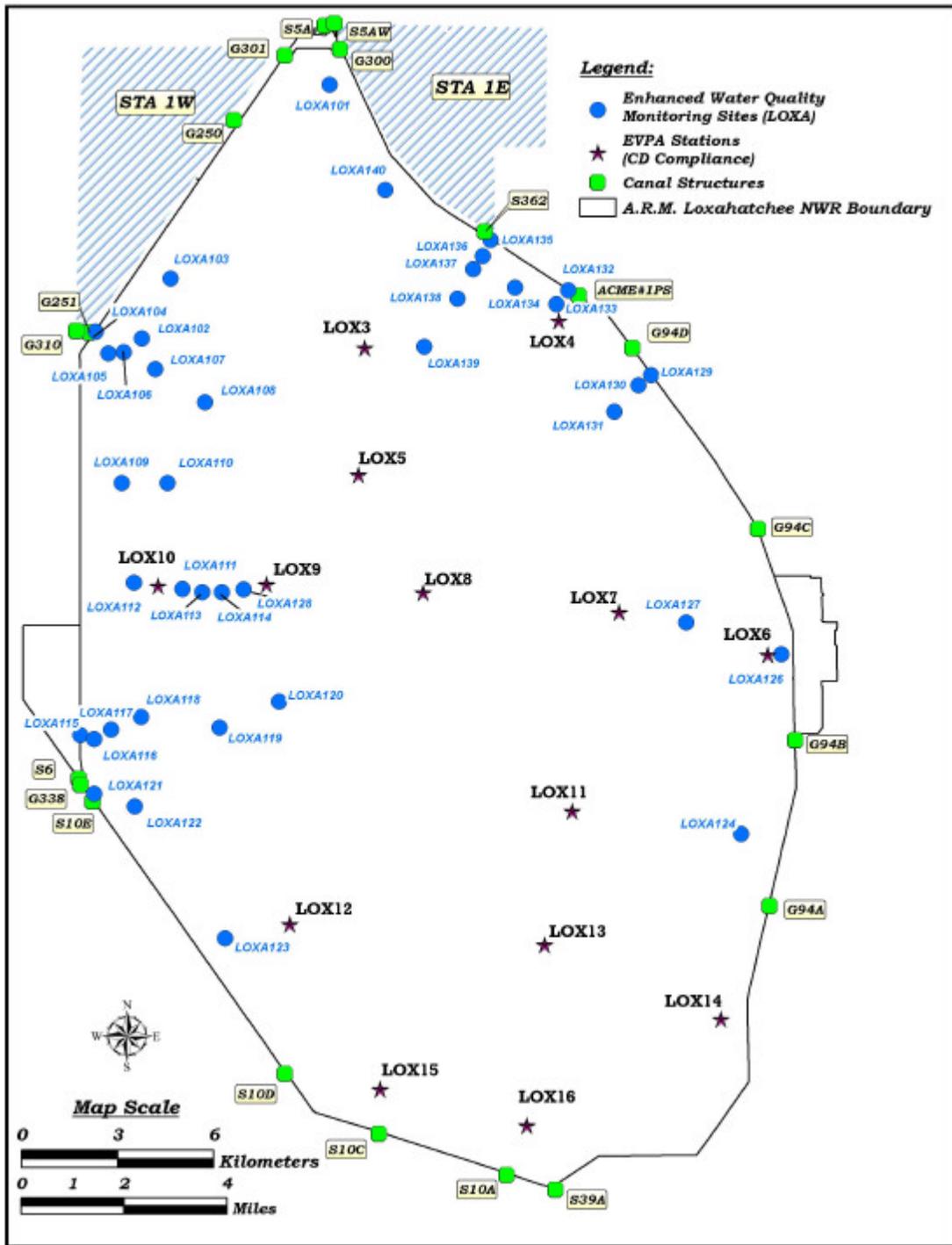


Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

Table 1. 2005-2006 Total phosphorus data (ppb) from the Enhanced Water Quality Monitoring Program for (a) marsh, and (b) canal stations for the A.R.M. Loxahatchee National Wildlife Refuge. Graphical representation of station locations are shown in Figure 1.

a) Marsh stations

Marsh Station	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Jun-05	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	May-06	June-06
LOXA101	11	11		25		58			18	13	14	12	10	8	11			
LOXA102	11			9		16			7	10	10	8	7	7				
LOXA103	15	42		16		21			7	8	14	10	7	6	7			
LOXA105	17	23				41			18	18	17	12	10	10	12			
LOXA106	10	14				21			9	13	18	10	8	6				
LOXA107						23				9	10	7		6				
LOXA108						28	12				8	8		6			7	
LOXA109	9	8	11		25	13	5	9	8	8	9	7	7	7	7			
LOXA110	24					18			8	8	8	6	6	7				
LOXA111	22	12				19			6	7	10	7	7	8				
LOXA112	10	12	12		24	15		8	7	9	8	8	8	8	9			
LOXA113	9	17				13	5	3	5	7	8	6	5	6	8	9		
LOXA114	15					25	6	6	5	7	8	5	6	5				
LOXA116	47	32	56		49	60	19	31	24		30	19	14	13	18	18		
LOXA117	8	12	11		21	35		13	15	19	17	9	10	9	10			
LOXA118	6	6	10		21	17	6	9	7	10	8	6	7	7	7	7		
LOXA119	12	5	71		52	32	5	6	6	7	7	5	6	5	6	6		
LOXA120	12	7			102	34	4	6	5	8	7	5	7	5	10	8	20	8
LOXA121	91	117						49	55			54		36				
LOXA122	9	12	16		29	14		12	11	12	11	8	11	5	11			
LOXA123	9	9	18		36	17	7	12	11			10						
LOXA124	9	15	19	106		24	13	7	16	11	13	7	9	7	9	10		
LOXA126	7	10	18	10		26	6	6	11	16	11	8	6	10	9	10		
LOXA127	6	7	11	12		10	6	7	8	7	7	7	7	6	9	9		
LOXA128	11					29	7			8	6	5	7	6				
LOXA130	15	16	17	28		63	17	13	12	14	24	13	8	9	10	14		9
LOXA131	6	7	8	14		12		6	6	6	6	7	8	5	8	13		8

Report No. LOXA06-004

LOXA133	265			44		155			31			15		15	16			
LOXA134	34	16	32	35		69	12	23	16	18	14	11	12	12	12	19		
LOXA136	154	77		30		72			29			24	27	12				
LOXA137	12	31	17	21	49	53	11	9	10	13	12	10	10	7	11	13		11
LOXA138	12	10		8	26	19	8		7	7	7	7	8	7	11			
LOXA139				9		18	9	8		8	8	8	8	7				
LOXA140	12	26	13			41	16		11	15	10	9	7	6	11			
MAX	265	117	71	106	102	155	19	49	55	19	30	54	27	36	18	19	20	11
MIN	6	5	8	8	21	10	4	3	5	6	6	5	5	5	6	6	20	8

b) Canal stations

Canal Station	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Jun-05	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	May-06	June-06
LOXA104	93	100	92		62	195	77	67	62	71	190	134	51	122	73	60	43	68
LOXA115	51	100	94		47	129	64	48	50	91	188	106	35	143	50	39	41	36
LOXA129	60	81	80	68		258	95	58	74	85	117	73	77	88	80	78	88	71
LOXA132	61	88	96	75		286	78		65	51	137	68	62	89	99	78	78	64
LOXA135	66	79	115	68	99	216	66	55	54	40	112	80	64	86	109	74	74	43
MAX	93	100	115	75	99	286	95	67	74	91	190	134	77	143	109	78	88	71
MIN	51	79	80	68	47	129	64	48	50	40	112	68	35	86	50	39	41	36

Table 2. August 2005- May 2006 Conductivity sonde deployment information, separated by transect, for the A.R.M. Loxahatchee National Wildlife Refuge. X = data collected from sonde deployment during that month. Graphical representation of station locations are shown in Figure 1.

Site ID	Description	2005					2006					
		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
LOXA104	NW Transect 0 (canal)	X	X	X		X	X		X		X	
LOXA105	NW Transect 0.5					X	X		X		X	
LOXA106	NW Transect 1	X	X	X	X	X	X		X		X	
LOXA107	NW Transect 2	X	X	X	X	X	X		X		X	
LOXA108	NW Transect 4	X	X	X	X	X	X		X		X	
LOXA111		X	X	X	X	X	X	X		X		X
LOXA112		X	X	X	X	X	X	X		X		X
LOXA113		X	X	X	X	X	X	X		X		X
<b>LOXA114</b>							X	X		X		X
LOXA115	SW Transect 0 (canal)	X	X				X		X		X	
LOXA116	SW Transect 0.5	X	X	X	X	X		X			X	
LOXA117	SW Transect 1	X	X	X	X	X		X			X	
LOXA118	SW Transect 2	X	X	X	X	X		X			X	
LOXA119	SW Transect 4	X	X					X			X	
LOXA120	SW Transect- X5	X	X	X	X	X		X			X	
LOXA126		X	X	X	X	X	X			X		X
LOXA127		X	X	X	X	X	X			X		X
<b>LOXA128</b>										X		X
LOXA129	NE Transect S 0 (canal)	X	X	X	X	X	X		X		X	
LOXA130	NE Transect S	X	X	X	X	X	X		X		X	
LOXA131	NE Transect S	X	X	X	X	X	X		X		X	
LOXA132	NE Transect N 0 (canal)	X	X	X	X	X	X		X		X	
LOXA133	NE Transect N	X	X	X	X	X	X		X		X	
LOXA135	NE Transect STA1E 0 (canal)	X	X	X	X	X	X		X		X	
LOXA136	NE Transect STA1E 0.5	X	X	X	X	X	X		X		X	
LOXA137	NE Transect STA1E 1	X	X	X	X	X	X		X		X	
LOXA138	NE Transect STA1E 2	X	X	X	X	X	X		X		X	
LOXA139	NE Transect STA1E 4	X	X	X	X	X	X		X		X	
LOX6	EVPA site	X	X	X		X	X	X		X		X
LOX7	EVPA site	X	X	X		X	X	X		X		X
<b>LOX8</b>	EVPA site			X	X	X	X	X		X		X
LOX9	EVPA site	X		X		X	X	X		X		X
LOX10	EVPA site	X		X		X	X	X		X		X

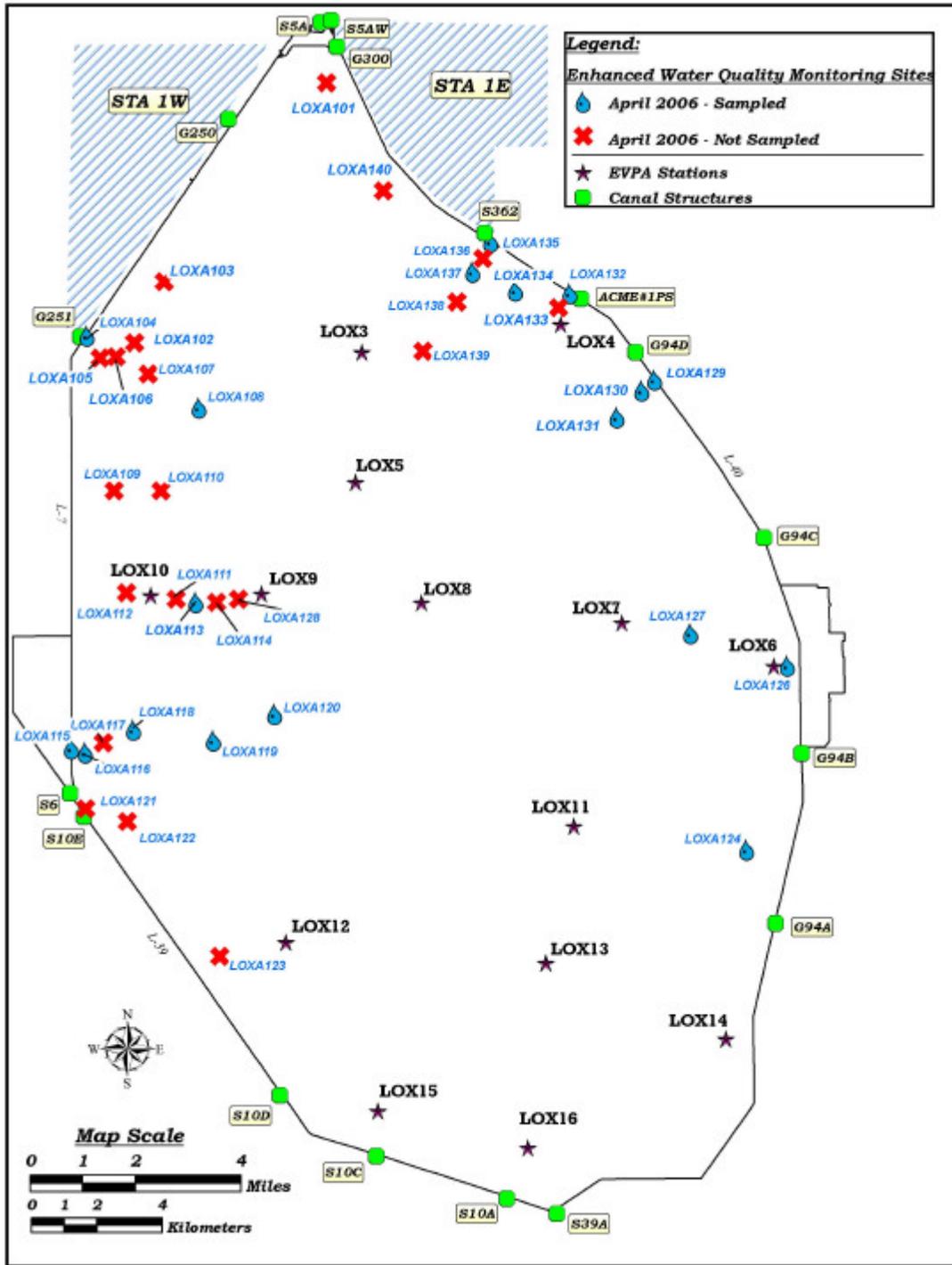


Figure 2. April 2006 map of total phosphorus values from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

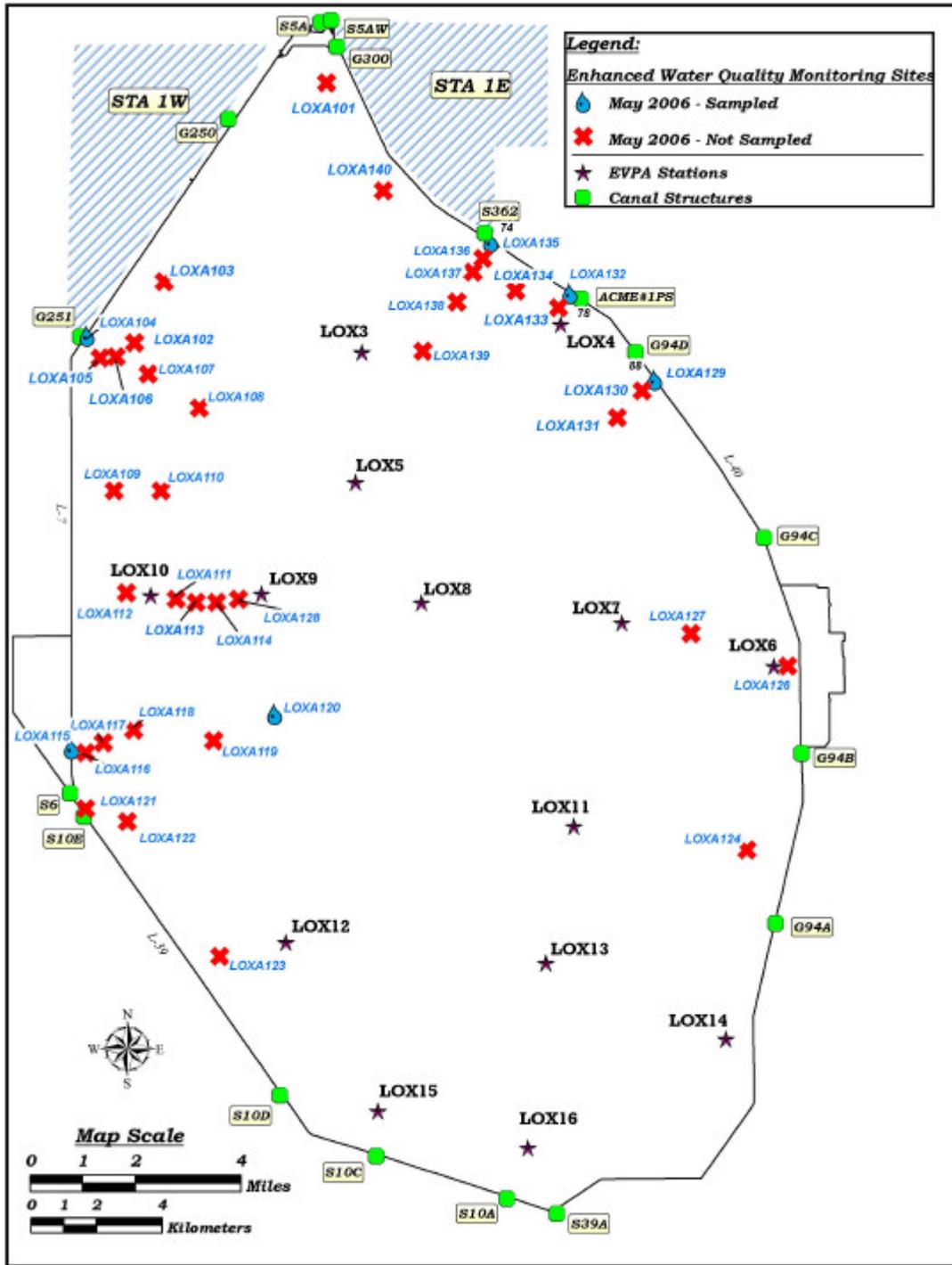


Figure 3. May 2006 map of total phosphorus values from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.